PATENT CLAIMS

1.   A method of managing a network, especially an optical network, including a plurality of nodes which are interconnected in an arbitrary topology so as to be capable of carrying traffic between selected nodes, comprising the steps of

1.1   providing a supervisory network by means of supervisory channels between the nodes;

1.2   providing a node manager which is comprised of one or more software modules in each node;

1.3   establishing of supervisory connections over one or more supervisory channels between selected nodes through which the node manager communicates with other node managers in other nodes;

1.4   providing a node module in each node manager that provides an interface to the hardware settings of the respective node;

1.5   providing a master module in at least one node manager;

1.6   establishing of supervisory connections over one or more supervisory channels between selected nodes through which the master module communicates with the node modules;

1.7   amending and/or monitoring of hardware settings in selected nodes with the respective node module of the node;

1.8   controlling of the amendments carried out by the node modules and/or processing of the monitored hardware settings by the master module.

2.   The method of managing a network according to claim 1, comprising the further steps of

2.1   providing a master module in several or all node managers, whereby each master module is either in an active state or a passive state;

2.2   setting of a single master module to the active state and maintaining or setting of the other master modules to the passive state; whereby

2.3   controlling of the amendments carried out by the node modules and/or
       processing of the monitored hardware settings is carried out only by the
       master module that is in the active state.

5   3.   The method of managing a network according to claim 2, whereby the
             setting of the state of the several master modules is done automatically.

       4.   The method of managing a network according to claim 3, comprising the
             further steps of

10   4.1   periodically generating heartbeat messages in each node and exchanging
             these messages among all nodes, whereby each heartbeat message
             contains information about the state of master module of the respective
             node;

       4.2   processing of the received heartbeat message in each node and setting of

15   the state of the master module in the respective node depending on the
             information in the received messages, such that always a single master
             module of all nodes is in the active state.

       5.   The method of managing a network according to claim 4, comprising the

20   further step of providing of each master module with an initial passive state
             when the node manager of the respective node is initialized, and whereby
             the changing of the state of the master module in the respective node is
             made according to one of the following decisions:

       5.1   if the master module of the node is in the passive state and the node

25   receives at least one heartbeat message that contains information about a
             master module of another node being in the active state the master module
             of the respective node remains in the passive state;

       5.2   if the master module of the node is in the passive state and the node
             receives no heartbeat message that contains information about a master

30   module of another node being in the active state within a predetermined

time interval the master module of the respective node changes into the active state.

6. The method of managing a network according to claim 4 or claim 5, whereby each heartbeat message generated in each node further contains the node ID of the respective node and changing of the state of the master module in the respective node according to one of the following decisions:

6.1 if the master module of the node is in the passive state and the node receives at least one heartbeat message that contains information about a master module of another node being in the active state the master module of the respective node remains in the passive state;

6.2 if the master module of the node is in the passive state and the node receives no heartbeat message that contains information about a master module of another node being in the active state within a predetermined time the node compares its ID with other received IDs using a predetermined procedure and depending on the result of this procedure, especially if its ID is smaller than other received IDs, the master module of the respective node changes into the active state;

6.3 if the master module of the node is in the active state and the node receives no heartbeat message that contains information about a master module of another node being in the active state within a predetermined time the master module of the respective node remains in the active state;

6.4 if the master module of the node is in the active state and the node receives at least one heartbeat message that contains information about a master module of another node being in the active state the node compares its ID with other received IDs using a predetermined procedure and depending on the result of this procedure, especially if its ID is not smaller than other received IDs, the master module of the respective node changes into the passive state.

7. The method of managing a network according to one of claims 1 to 6, comprising the further steps of:

7.1 the node module in each node communicates with the master module either through a full set of supervisory connections or a reduced set of supervisory connections; whereby

7.2 in the full set of supervisory connections, each node module communicates with all master modules present in one or more nodes, especially whether in the active state or passive state;

7.3 in the reduced set of supervisory connections, each node module communicates only with a single master module present in one node, or especially with a single master module in an active state present in one node.

8. The method of managing a network according to one of claims 4 to 7, comprising the further steps of:

8.1 providing a master controller module in each node which is connected to the master module of the respective node;

8.2 the master controller modules of different nodes generate, exchange and process the heartbeat messages and control the state of the master module of the respective node.

9. The method of managing a network according to claim 8, whereby the node module in each node communicates only with the master module in the active state and in the case of changing the state of the master module to the active state and a further master module to the passive state the supervisory connections through which the communication takes place are reconfigured.

10. The method of managing a network according to claim 9, whereby the master controller module of the node with the master module that has been

changed to the active state sends a reconfigure message to each node containing the ID of its node.

11.   The method of managing a network according to one of claims 2 to 10, comprising the further steps of:

11.1   providing a database containing information relating to hardware state of each node as well as local and global network management activities in each node;

11.2   synchronizing of the database in each node according to the following steps

11.3   before a master module is set to the active state the corresponding node, especially the master controller module of the corresponding node, sends the current state of the database of the corresponding node to all other nodes, especially the master controller of all other nodes;

11.4   the receiving nodes, especially the master controller modules of the receiving nodes, synchronize its database with the received state of database.

12.   The method of managing a network according to claim 11, comprising the further steps of:

12.1   the master module in each node informs the master controller in the corresponding node of any changes in the database of the node;

12.2   the master controller sends these changes to other master controllers in all other nodes;

12.3   when a node comes up after a failure the master controller in that node requests for the current state of the database from the master controller of the node with the master module in the active state to synchronize its database with the database of the node with the master module in the active state.

13.   A network management system of a network including a plurality of nodes
        which are interconnected in an arbitrary topology so as to be capable of
        carrying traffic between selected nodes, whereby

13.1   the nodes are interconnected by a supervisory network that is provided by
        supervisory channels between the nodes;

13.2   each node has a node manager which communicates with other node
        managers through a supervisory connection established over one or more
        supervisory channels between selected nodes;

13.3   each node manager includes a node module which provides an interface to
        the hardware of this node which allows for amending and monitoring of
        amendments of the hardware settings of this node;

13.4   at least one node manager includes a master module which is connected to
        the various node modules through supervisory connections established
        over one or more supervisory channels between selected nodes;

13.5   the master module provides functionality for controlling of the node modules
        and the amending of the hardware settings and for processing of the
        hardware settings monitored by the node modules.

14.   The network management system according to claim 13, whereby the
        master module includes an interface to support one or more Graphical User
        Interfaces located in one or more nodes.

15.   The network management system according to claim 13 or 14, whereby the
        master module includes one or more software modules for global and local
        network management and especially one or more software modules for
        database related tasks and features for a database containing information
        relating to hardware state of each node as well as local and global network
        management activities in each node.

16.   The network management system according to one of claims 13 to 15,
        whereby several or each node manager has a master module; and

16.1   each master module could be set to the passive state or to the active state, whereby only in the active state the respective master module has the said functionality, whereas in the passive state it mainly has the functionality of performing database synchronization.

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17.   The network management system according to claim 16, whereby each node further comprises a master controller module for setting of the state of the respective master module.

10   18.   The network management system according to one of claims 13 to 17, whereby the network management system is managed by a method according to one of claims 1 to 12.

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